mystery of how the correct and incorrect expression of telomerase is linked to the development of cancer.

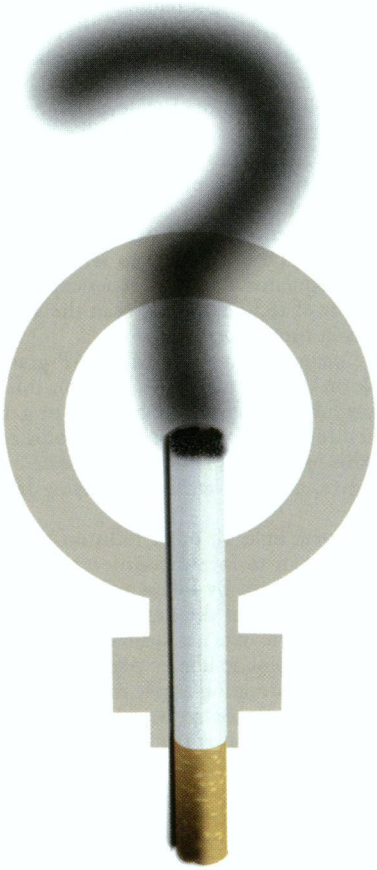
The first group to describe the gene was headed by Toru Nakamura and included Nobel Prize winner Thomas Cech of Colorado University at Boulder and the Howard Hughes Medical Institute, as well as six additional authors, five of whom work for Geron Corporation of Menlo Park, California. Their findings were published in the 15 August 1997 issue of *Science*. "We hope the cloning of this gene will lead to the discovery and use of new drugs in the fight against cancer," said Greg Morin of Geron, one of the coauthors.

In the 22 August 1997 issue of *Cell*, a second group, led by Matthew Meyerson of the Massachusetts Institute of Technology (MIT), announced their discovery of the same gene. The group also included Robert Weinberg of the Whitehead Institute of Biomedical Research at MIT and eleven others.

Jerry Shay, a professor of cell biology and neurosciences at University of Texas Southwestern Medical Center in Dallas and a recognized leader in telomerase research, said of the simultaneous cloning of this gene, "This is important because we can now begin to understand how telomerase works. If we can't find a cure for cancer, we need to start detecting it earlier so we can stop it—or control it—before it spreads. Telomerase can be used as an early definitive marker of cancer."

Also newsworthy is the way in which the telomerase gene was cloned. "It should have taken a couple of years to clone," said Shay, "but because the Human Genome Project clones ESTs [expressed sequence tags] the groups were able to pick it out through its homology to the yeast telomerase gene." An EST is a 400- or 500-base-pair fragment that is identified through random sequencing of cDNA libraries. The groups were able to look at these ESTs and identify those that showed homology, or identical sequence, with the already identified yeast telomerase gene. Therefore, the work of the Human Genome Project accelerated by years the cloning and identification of an unknown gene.

"This is all early, basic, science-type stuff. We are a long way from being able to extend life and cure cancer," said Shay. "But these are profound things to even be contemplating."



A question of cancer. New evidence shows that environmental tobacco smoke may have serious health effects for women including a strong link to cervical cancer.

A New Reason Not to Smoke

New evidence provides support for the argument that smoking may cause cervical cancer, not just in smokers but also in nonsmoking women who are exposed to environmental cigarette smoke. The study, reported in the 18 June 1997 issue of the *Journal of the National Cancer Institute*, is the first to find a tobacco-specific carcinogen in samples of cervical mucus taken from both smoking and nonsmoking women. The carcinogen is 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), an *N*-nitrosamine that is formed during the processing and burning of tobacco products. NNK is one of the most potent carcinogens found in tobacco smoke. It has been detected in the sidestream smoke of cigarettes (the smoke that wafts from a smoldering cigarette), which means that not only smokers but also nonsmokers who breathe in secondary cigarette smoke are exposed to NNK.

The study was conducted by Bogdan Prokopczyk, head of the section of bio-organic chemistry in the division of cancer etiology and prevention at the American Health Foundation in Valhalla, New York, and Steven E. Waggoner, an assistant professor of gynecologic oncology at the University of Chicago Medical Center, and colleagues. The study cohort consisted of 25 women, 15 of whom smoked and 10 of whom did not smoke. The women were aged 18–45, were free of any active genital tract disease, and were not currently using oral contraceptives. The scientists collected cervical mucus samples from the women and used highly sensitive gas chromatography–mass spectrometry analyses to identify and quantify the NNK in the samples. Of 26 samples taken (one woman gave two samples), only one—taken from one of the nonsmoking women—did not contain some measurable amount of NNK. Among the other 9 nonsmokers, NNK concentrations ranged from 4.1 to 30.8 nanograms per gram (ng/g) of mucus, approximately one-third lower than the amounts found in the samples taken from the smokers, which ranged from 11.9 to 115.0 ng/g.

Scientists have known for some time that there is a link between cigarette smoke and cervical cancer, but the precise nature of the link is still uncertain. Prior research has determined that noncarcinogenic compounds from cigarette smoke, such as nicotine and its metabolite cotinine, can be detected in the cervical mucus. There is also evidence that cigarette smoke is capable of causing damage to DNA in cervical epithelial tissue. But the new findings are the first time that a carcinogen specific to tobacco has been found in the cervical mucus of women who smoke. The link between smoking and cervical cancer has been greatly strengthened by these latest findings, which, according to the report's authors, lend "biologic plausibility in support of the association between cigarette smoking and [cervical cancer]."

In the United States in 1996, there were an estimated 15,700 new cases of cervical cancer and 4,900 deaths from the disease. According the *JNCI* study, cervical cancer is the top cause of death from cancer in women in developing countries, and is one of the most common cancers among U.S. women aged 15–54. The foremost risk factor for cervical cancer is infection with certain strains of the human papillomavirus (HPV). The DNA-level effects of such viruses are found in up to 93% of all examined cervical tumors, but these effects alone are not thought to be enough to induce carcinogenesis. Many other factors are associated with cervical cancer, including deficiencies in micronutrients such as beta carotene and folate, impaired immune status, early onset of sexual activity, and cigarette smoking.